“De weg van de toekomst”

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FOREVER OPEN ROAD
Redefining Highway Transport for the 21st Century
Onze Team
De weg van de 5de generatie

- Past WOW! Factors in Road Construction?
  - 1st generation – the track?
  - 2nd generation - the paved road?
  - 3rd generation - the smooth road?
  - 4th generation - the continuous road/motorways?
  - What will the 5th Generation Be Like?

- We need start to develop the 5th Generation
  - Solves existing and future problems
  - Achievable through new technology

- Stakeholders need to be convinced that there’s a workable concept!
  - Must be a long-term multi-national solution
  - Must have lots of costs savings and benefits
Waarom?

- Address Global Challenges
- Climate Change
- Carbon Reduction
- Energy Generation
- Global Financial Crisis
Basisgedachten

- Takes all our existing ideas and produces one solution that will support all our future needs:
  - the Adaptable Road
  - the Automated Road
  - the Climate Change Resilient Road

- A concept that will...
  - be adaptable to future travel demands
  - provide low-cost automated travel
  - produce sustainable benefits

- Be Forever Open
In-built lane and vehicle direction information

Integrated driver/maintenance information system

Measures own Condition

Carbon Capture Planting & Devices

In-built electronic vehicle guidance systems

Built-in flood resistance

Pre-fabricated

Carbon free construction

Recycled materials

Bolt-on lanes and road infrastructure

Instant crack repair

Heat storage and energy harvesting

Snow and ice dispersing

Is dit de toekomst? Is dit mogelijk?
The Forever Open Road Concept

• Will have zero delays from:
  - congestion,
  - accidents,
  - roadworks,
  - maintenance,
  - weather

• The Forever Open Road is a concept of total resilience to meet our future road infrastructure requirements

• By being flexible and sustainable.
The adaptable road

Flexible, durable surface, easy repairs, self-cleaning, instant crack repair

In-built fixing system for central reserve barriers and traffic signs

Heat transfer grid and storage

In-built system for adding lanes / infrastructure

Adaptable communication / power channels for lane control, traffic monitoring, driver information and condition monitoring

Pre-fabricated sub-base incorporating drainage / communication channels

Removable drainage reservoir

Locked grid system for drainage / communication channels

In-built / removable sensors for traffic monitoring and road condition
The Adaptable Road

• A flexible and cost-effective road infrastructure system based on:
  • Pre-fabricated road construction
  • Low carbon, low energy, recycled materials
  • Rapid replacement and repair
  • Self-cleaning and self-repairing systems
  • Durable pavements – temperature control – reduced seasonal effects
  • In-built power systems for powering electric vehicles and road infrastructure
  • Robotised and automated on-road maintenance and traffic control
  • Integrated performance monitoring and measurement
  • Flexible drainage systems – storm resilient

• The Adaptable Road - key to making the Forever Open Road concept work
Adaptable and cost-effective

- Self-healing, self-cleaning materials
- Pre-fabrication
- Rapid and flexible maintenance techniques
- Flexible

- Aim is quicker and/or longer-lasting without cost penalty
The climate change resilient road

- Solar energy harvesting and storage for moderating pavement temperature to prevent frost and transfer energy to roadside infrastructure
- Roadside lighting and signs powered by captured energy
- Porous surfacing / light reflecting surfacing
- Carbon capture planting fed by run-off water
- Drainage and reservoirs for storm control and water collection
- Low carbon sub-base and pavement
- Energy harvesting grid and storage system
The Resilient Road

- Ensuring accessibility, economically sustainability, and resilience to climate change through the:
  - development of risk-based methodologies
  - application of technologies
  - introduction of management and adaption strategies

- A research and innovation programme includes:
  - assessment and mapping of the vulnerability of the road network
  - evaluation of risks and costs of adaption
  - new designs for resilient drainage, soil strengthening, rock stabilization, and long-life and low maintenance pavements and structures
  - development of improved modelling to predict weather impacts, adaption strategies and guidelines.

- The Resilient Road - protecting the road network from the effects of extreme weather events and ensuring network availability
Resilient and reliable

- Ice-resisting materials
- Snow clearing systems
  - Design and operation
- Flood mitigation
- Heat island reducing
- Pollution reducing (incl. road dust)
The automated road

- Satellite and radio communications to road infrastructure and drivers
- In-built vehicle guidance infrastructure and co-operative vehicle-highway system
- Driver information systems linked to sensors and in-car devices
- Weather warning systems linked to automated sensors
- In-pavement demand responsive sensors and guidance systems for lane and speed control
- Temperature, moisture, pavement condition monitoring and road asset management system communications
- Adaptable communication / power channels for lane control, traffic monitoring, driver information and condition monitoring
The Automated Road

• Meeting road user demand through:
  • intelligent traffic management strategies (ITMS) working at a network level
  • advanced roadside systems (ARS) working at a local level

• A research and innovation programme covering eight entities in transition:
  1. road user
  2. measures
  3. traffic control centres
  4. management principles
  5. organisation
  6. vehicles
  7. infrastructure
  8. data and information

• The Automated Road - moving from managing the collective at a local level to managing the individual on a network-wide basis
Automated and intelligent

- Advanced modelling and visualisation
  - Asset management
  - Planning
  - Maintenance
  - Public perception

- Intelligent components
The Challenges

- How Do We Make It Work?
Infrastructure is recognised........

Figure 1: **Road and pavement repairs are a high priority for residents**

- Activities for teenagers
- Road and pavement repairs
- The level of traffic congestion
- The level of crime
- Clean streets
- Public transport
- Affordable decent housing
- Job prospects
- Facilities for young children
- Shopping facilities
- Wage levels and local cost of living
- Sports and leisure facilities
- Community activities
- Health services
- Parks and open spaces
- The level of pollution
- Cultural facilities (e.g. libraries, museums)
- Education provision
- Access to nature
- Other
- Race relations

% of respondents who feel the service area needs improving

*Source: Place Survey 2008, DCLG*
The future approach

A collaborative approach will be needed for:

• Optimising capacity of the network and increasing the efficiency of goods transport

• Preventative and mitigating Road Engineering for safety

• Reducing energy consumption, environmental impact and nuisance and societal/cultural impacts

• Implementation of innovation

• Development of better – integrated - standards & Directives
Rocks for the future

• (and especially their infrastructure) will need to:

  • contribute to sustainability
  • make wide use of innovation
  • contribute to improvements in road safety, environment and road transport efficiency
Can we improve without innovation?

• Improving infrastructure is possibly under more pressure than ever.
• Maintenance costs are increasing
• Budgets are not!
• Public expectations are growing
• Safety, congestion and environmental pressures
## Societal Challenges

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<thead>
<tr>
<th>Challenge</th>
<th>Indicator</th>
<th>FOR Guiding Objective</th>
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<tbody>
<tr>
<td>Decarbonisation</td>
<td>Energy efficiency of passenger and freight transport (kWh)</td>
<td>+10% to 20%</td>
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<tr>
<td>Innovation</td>
<td>Energy consumed by road operators and in embodied materials</td>
<td>Net zero -25%</td>
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<tr>
<td>Reliability</td>
<td>Failure frequency and duration time lost in delays</td>
<td>-35% -50%</td>
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<tr>
<td>Safety &amp; Security</td>
<td>Fatalities and severely injured Goods lost to theft and damage</td>
<td>-35% -40%</td>
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<tr>
<td>Liveability</td>
<td>Air quality, noise and natural habitat</td>
<td>Policy compliance</td>
</tr>
<tr>
<td>Cost</td>
<td>Total cost of ownership</td>
<td>-30%</td>
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## Drivers

<table>
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<tr>
<th>External Driver</th>
<th>The Role of the Forever Open Road</th>
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<tbody>
<tr>
<td>Ageing infrastructure</td>
<td>providing new cost-effective solutions for design and maintenance</td>
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<td>Scarcity of natural resources</td>
<td>regenerating and re-using materials</td>
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<td>Economic development</td>
<td>capturing new technology and advanced thinking to link transport holistically to land use planning</td>
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<tr>
<td>Demographic changes</td>
<td>adapting to changes in demand for mobility</td>
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<tr>
<td>Increasing traffic volumes</td>
<td>coping with changing demand for road travel when budgets for road infrastructure decrease</td>
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<tr>
<td>Rapid development of technology</td>
<td>providing new communications, control and power systems</td>
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Delivering a joined-up approach

• Structurally - and politically - infrastructure research (and especially implementation) is not the same as industrial research.

• To be successful, we need to involve a greater number of countries in our research in order to avoid the ‘not invented here’ and the ‘it cannot work here’ syndrome.

• At a national level, partnerships with industry have traditionally been successful. But we have not yet scaled this up to the European level.
Challenges to keep infrastructure fit for purpose

for both vehicles and people
Stimulating innovation 1989-2012
Aspects for Energy-efficient roads

**Construction**
- Recycling of Materials
- Cold mixes
- Modular urban pavement

**Energy**
- Mechanical energy
- Geothermal energy
- Solaroad

**Mobility**
- Inductive charging
Research Infrastructures

- Cooperation will be needed for developing the research/testing infrastructures needed
  - to develop FOR concepts
  - addressing new technological issues and challenges such as climate change adaptation

Hard and soft facilities including
La route de la 5ème génération- France

• Aims to demonstrate the integration of numerous innovations
• Research themes organised for urban, peri-urban, interurban and local networks and…
  • The adaptable road
  • The resilient road
  • The automated road
  • The acceptable road

• From single innovations to sub-system proving to design and construction of full-scale research demonstrators
Ferry Free E39 - Norway

• Aims to clarify the technological challenges and possibilities and explore the benefits of developing the E39 Coastal Highway as a more efficient corridor with no ferry connections

• Aims to reduce the travel time from Kristiansand to Trondheim by 7-9 hours by replacing eight Ferry Connections

• Innovative solutions to be developed for:
  • Long span structures
  • Generation of power from solar, current, wave and wind energy sources
Exploratory Advanced Research Program – USA

• Aims to achieve long-term improvements in the planning, renewing and operation of safe, congestion-free and environmentally sound transportation facilities
• Focused on breakthrough, high-risk research with a high payoff potential
• Critical research issues include:
  • Connected highway and vehicle system concepts
  • Breakthrough concepts in material science
  • Human behaviour and travel choices
  • New technology and advanced policies for energy and resource conservation
  • Technology for assessing performance
  • Nano-stage research and information sciences
Aims to develop safer, more economical, efficient, reliable and intelligent roads, with innovative uses

Seven thematic profiles
1. The safe and reliable road
2. The intelligent road
3. The energy-saving road
4. The low emission road
5. The road as part of the environment
6. The sustainable road
7. The road as a future innovator
Voorbeeld: Demonstratie-, onderzoek- en referentiezone van BASt bij Köln-Ost
Demonstratie en onderzoeken: Intelligente Wegenbouw

Sensorik:
- Dehnungen
- Spannungen
- Temperatur
- Feuchte

Variante 1

Variante 2

Untersuchung
Simulation
Variation
Innovativer Straßenaufbau

Beata Krieger
Demonstratie en Onderzoeken: Intelligente Bruggen

- **RFID-Tags**
zur Identifikation und Diagnose von Bauteilen der intelligenten SVIS

- **Integrierte drahtlose Sensorsysteme**
zur Messung von Einwirkungs- und Widerstandsgrößen im Brückenbau

- **Selbstorganisierte drahtlose Sensornetze**
Messungen erfolgen ereignisbasiert oder kontinuierlich; einzelne Sensoren „kommunizieren“ untereinander

- **Intelligente Energieversorgung am Bauwerk**
die energieautarke Brücke
Referentietraject
Veilige en betrouwbare weg
Geïntegreerde en duurzame infrastruktuur

- Das **Dienstgebäude** soll nach Nachhaltigkeitsaspekten erstellt werden.
  - Es soll einen Gesamterfüllungsgrad über 80 % nach dem Bewertungssystem **Nachhaltiges Bauen des Bundes** (BNB) erreichen.
  - Es soll als Energie-Plus-Haus gekoppelt mit einer **Ladestation für Elektrofahrzeuge** konzipiert werden.
  - Ein ansprechendes Design für die Dienstgebäude der Zukunft aufweisen.
- Nachhaltige und innovative Energiegewinnung zur Absicherung des Eigenstrombedarfes.

Beata Krieger
Project Portfolio

• 32 Projects listed on FOR website – others waiting to be added

• Selected examples:
  – Composite pavements (BASt)
  – Design for extreme weather (RWS)
  – **Wireless Recharging of Vehicles from Road Pavements (BRRC)**
  – Pavement Power (TRL)
  – SOLAROAD – Solar cells in the road surface (TNO)
  – Tomorrow’s Road Infrastructure Monitoring and Management (VTI)
  – Implementation of SWAMP (avoiding/limiting the consequences of flooding in the highway network) (RWS)
  – Laser Line Marking (NPRA)
Om de weg van de toekomst te ontwikkelen…

“We need to be aware of what context we are working in and look over the barriers”
Besluiten

• Infrastructuur is de basis van mobiliteit’

• Niet noodzakelijk meer maar beter:
  • Beter gebruikt,
  • Beter onderhouden ,
  • Beter herkend

• Innovaties bestaan reeds, maar er kan nog veel meer!

• Het OCW is klaar om AWV in deze uitdagingen te steunen!

Vragen?